RESEARCH HIGHLIGHTS

Technical Series 01-122

AIR INFILTRATION FROM ATTACHED GARAGES IN CANADIAN HOUSES

Introduction

The indoor environment in houses has a significant impact on the occupants' health and comfort. This study was initiated by Health Canada with contributions from both Environment Canada and Canada Mortgage and Housing Corporation to evaluate effects of automotive emissions from attached garages on the indoor environment in Canadian single-detached houses, and the impact on occupants' health. This work consisted of testing a total of 25 houses in the Ottawa area to characterize the extent of leakage between the attached garages and houses. The selected houses were from various age groups, styles and types of attached garages.

Research Program

The airtightness testing was the first stage of a comprehensive Health Canada study. Other phases include pollutant concentration measurements in the garage and the house, and modeling the movement of pollution from the garage to the house.

The air leakage characteristics of the house/garage interface were determined by fan depressurization tests. Essentially, two tests were done to isolate the leakage through the house/garage interface. The first test was a depressurization of the house with the garage vehicle door opened to provide the house characteristics including the air leakage through the interface. The second house airtightness test was done while the garage was simultaneously depressurized to eliminate the airflow through the common surfaces between the house and garage.

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Findings

Table 1 shows a summary of the garage characteristics for 10 of the 25 houses for which all of the pressurization data—for both winter and summer testing periods was collected. The percentage of the house envelope leakage attributed to leakage through the house/garage common elements is shown in Figure 1.

The research produced the following findings based on the 25 houses:

- Most of the air leaks from the garage were found to be leading into the basement.
- In four houses, leaks from the garage into the main floor were more significant than leaks into the basement. Although some leakage was detected from the garage into the second storey space of some houses, these leaks may not be significant routes of garage pollutant entry in the house depending on house pressures.
- The house/garage interface leakage, as characterized by a variation on the Equivalent Leakage Area (ELA), ranged from 4 cm^2 to 400 cm^2 with an average of 140 cm^2. The interface leakage area averaged 13% of the overall house leakage area (see Figure 1). This is almost proportional to the ratio of interface area to house envelope area. In other words, the house/garage interface is built roughly as leaky as the rest of the house envelope.

Table 1

House	Garage volume (m^3)	Common surface area (m^2)	Finished surfaces	Insulated surfaces	House gar Attachment	Interface leakage area ELA (cm^2)	House/garage pressure difference summer (Pa)			House/garage pressure difference winter (Pa)		
							ave	max	min	ave	max	min
A	91.9	30.5	walls and ceiling	none	2 sides + room above	201	0	1.6	-1.2	1.6	2	1.3
B	63.4	11.7	none	none	1 side	4	0.4	1.8	-2.3	1.4	1.7	1.1
C	100.9	73.3	walls and ceiling	walls and ceiling	2 sides + room above	272	0.7	1.3	0.2	3.4	4.4	3.1
D	69.4	50.5	walls and ceiling	walls and ceiling	1 side + room above	72	0.8	1.6	0.2	1	1.2	0.8
E	66.9	19.4	ceiling	none	1 side	5	0.9	4.6	0.2	0.5	0.5	0.4
F	82.4	28.3	none	ceiling	1 side + room above	166	0.4	1.3	-0.6	2.1	2.4	2
G	119.6	24.3	none	none	1 side	89	0.7	2.8	-0.2	1.1	1.1	1
H	67.7	24.4	walls and ceiling	walls and ceiling	2 sides	50	0.9	2.4	-0.4	1.7	1.8	1.6
I	110.9	34.6	walls and ceiling	none	2 sides	76	0.9	3.4	-0.2	1.2	1.4	1
J	151.9	12.9	none	none	2 sides	98	0.8	2.3	0	2.3	2.8	2
max	119.6	73.3				402	0.9	4.6	0.2	3.4	4.4	3.1
min	63.4	11.7				4	0	1.3	-2.3	0.5	0.5	0.4
average	92.5	31				140	0.6	2.3	-0.5	1.6	1.9	1.4
st.dev.	28.7	18.6				106	0.3	1.2	0.8	0.9	1.2	0.8

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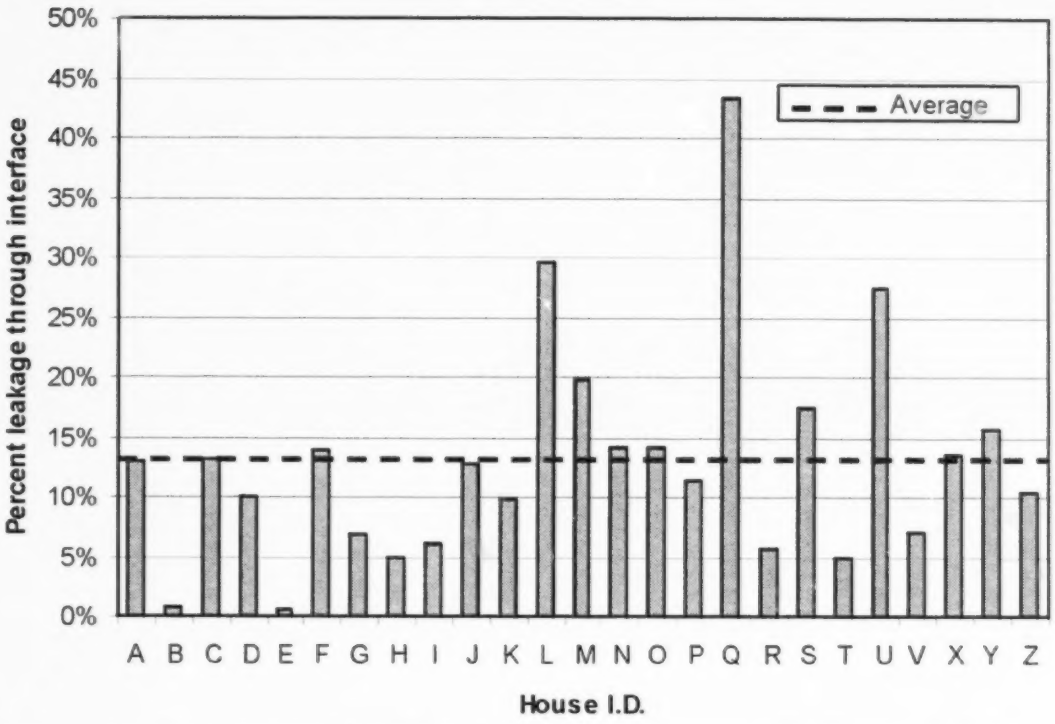
Figure 1: Percent of House Air Leakage Through House/Garage Interface



- The average monitored pressure difference between the house and garage during the summer measurement period was 0.5 Pa. The range of pressure was from –2.3 Pa to 4.6 Pa. Winter pressures were much higher averaging 1.6 Pa with a range of 0.4 Pa to 4.4 Pa.

Implications for Building Industry

The results of this study show that garage/house air exchange is significant and can be an entry point for pollutants from the garage and vehicles.

Until the completion of modeling and data analysis, it is not possible to state whether this leakage will cause major health effects, and whether attached garages will have to be treated differently to reduce automobile pollutants from indoor air.

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Housing Research at CMHC

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